



AIRS v6 surface parameter testing, validation plans

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Hughes, Simon Hook

Jet Propulsion Laboratory, California Institute of
Technology

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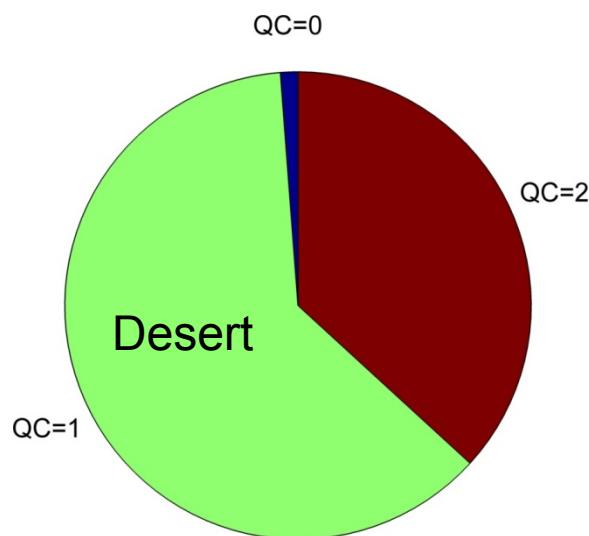
NASA Sounder Science Team Meeting
Greenbelt, MD
Nov 13-16, 2012

Outline

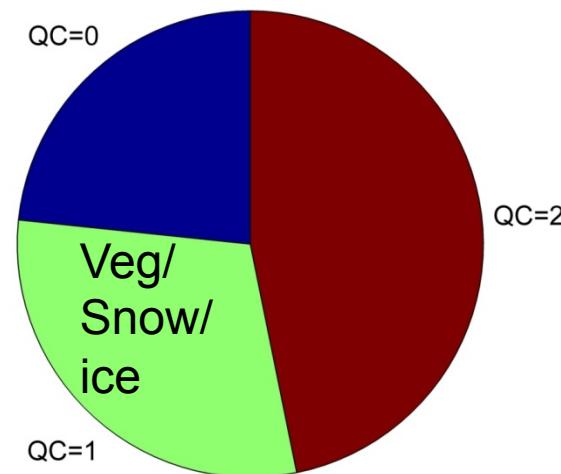
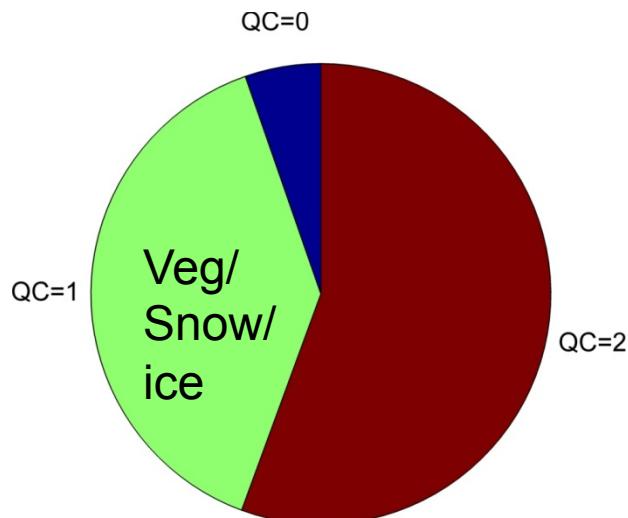
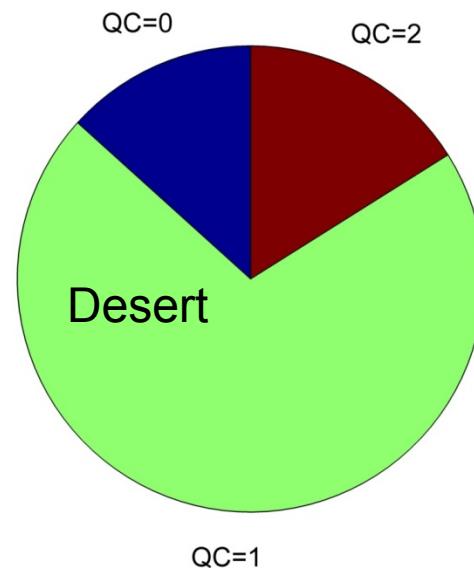
1. AIRS v6 LST&E testing results
2. A new MODIS LST&E Product
3. ASTER Global Emissivity Map (ASTER-GEM)
4. AIRS v6 validation plans
 - Validation sites
 - Temperature-based validation
 - Radiance-based validation

Surface Yields

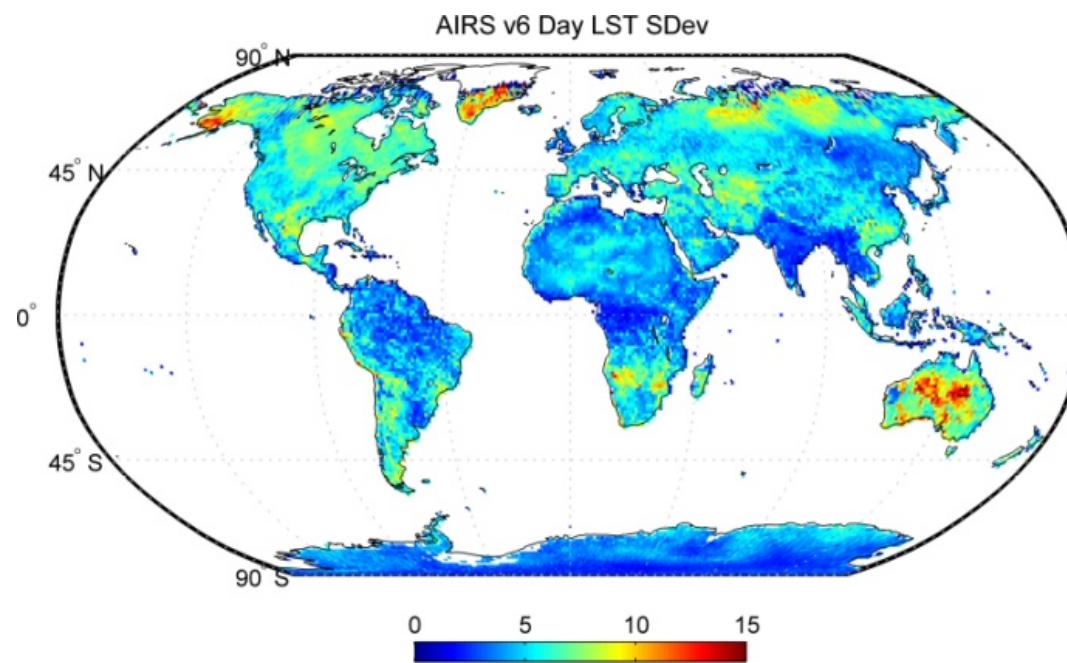
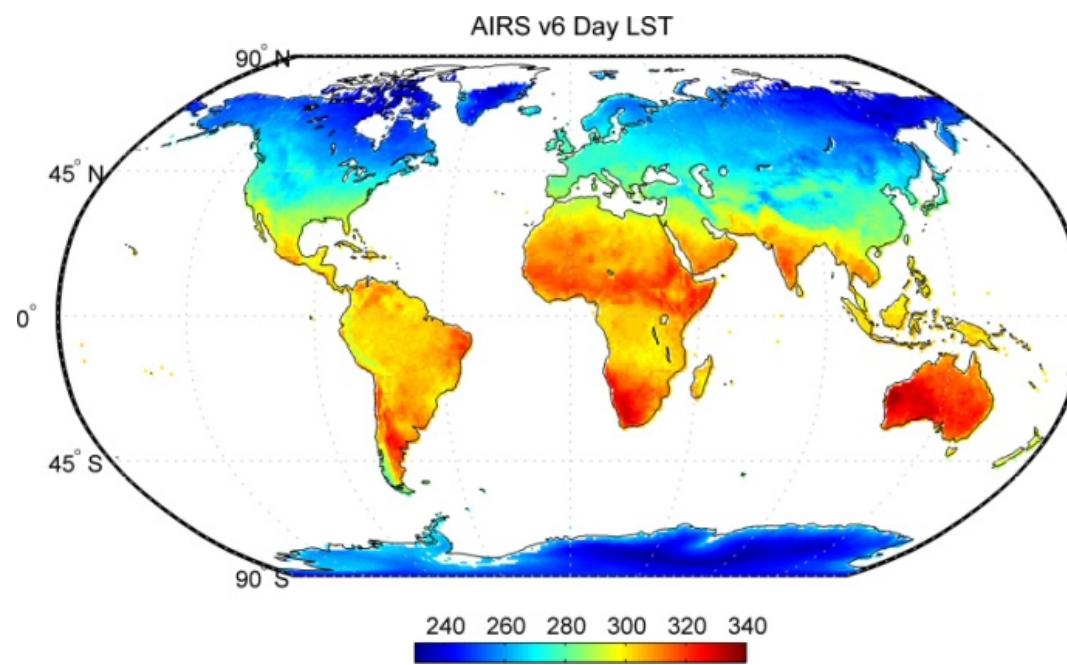
V5



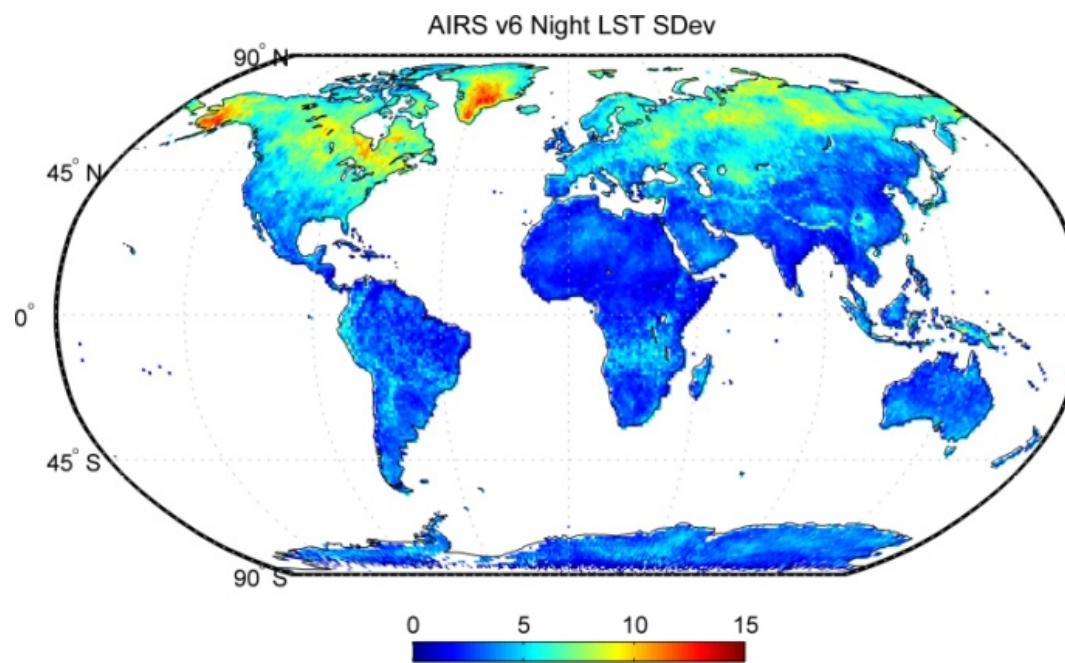
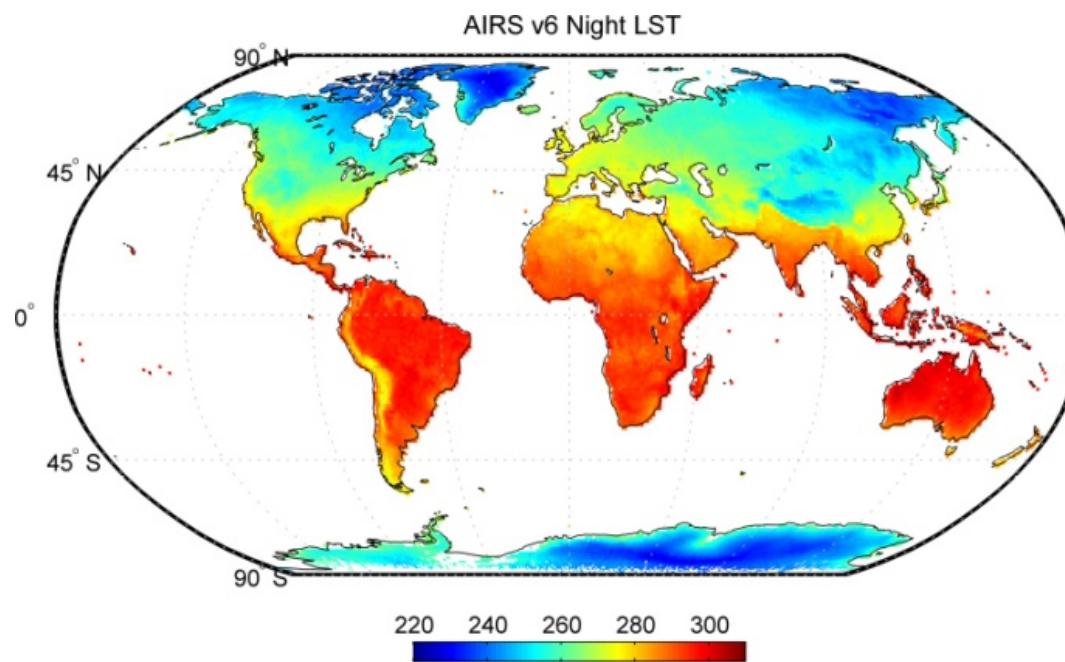
V6



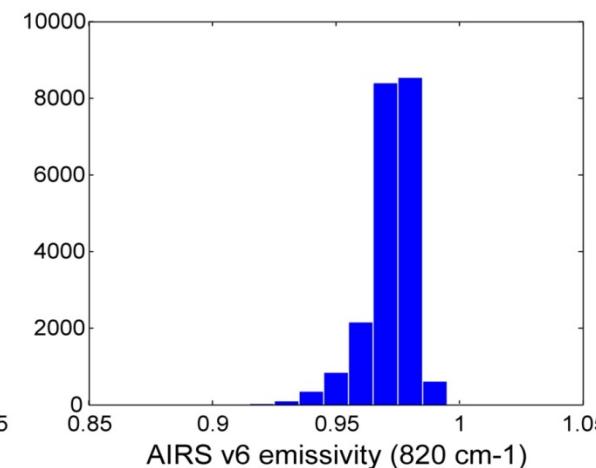
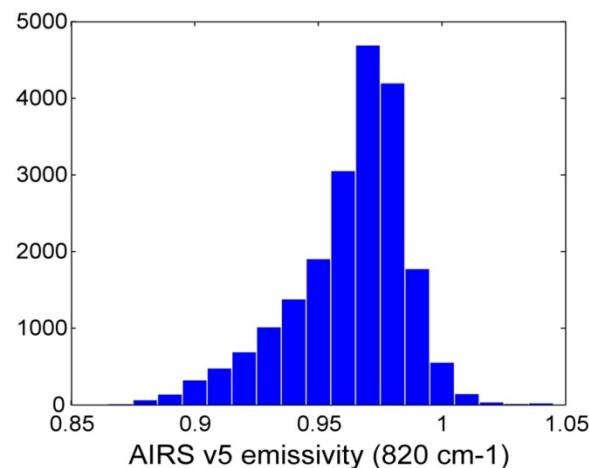
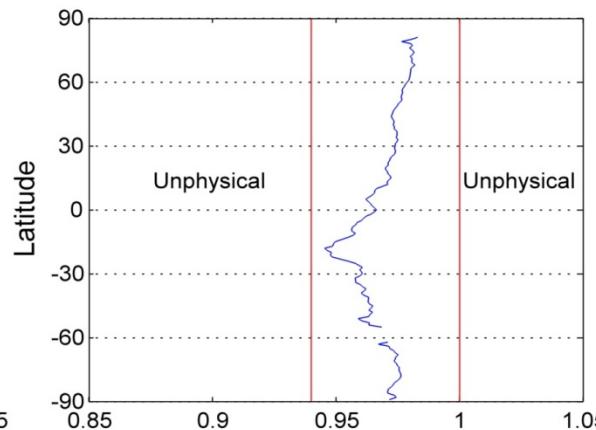
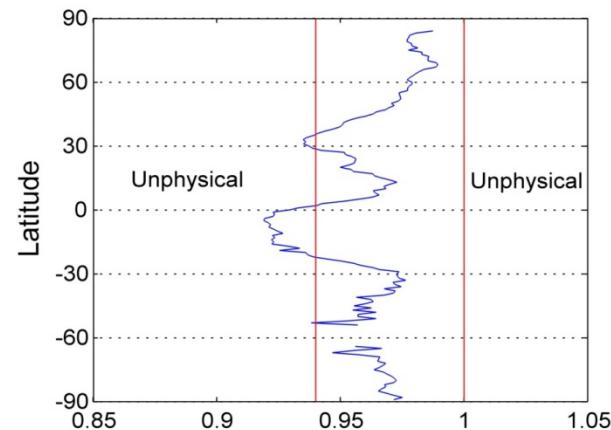
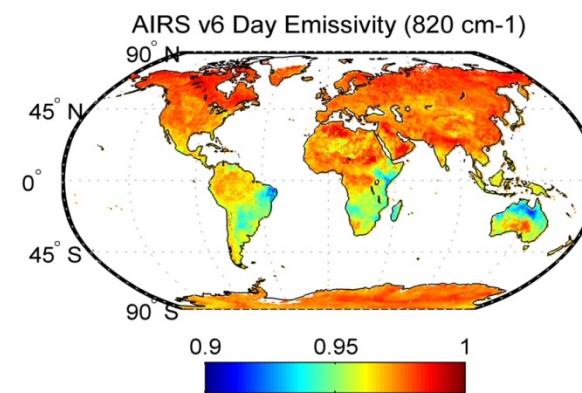
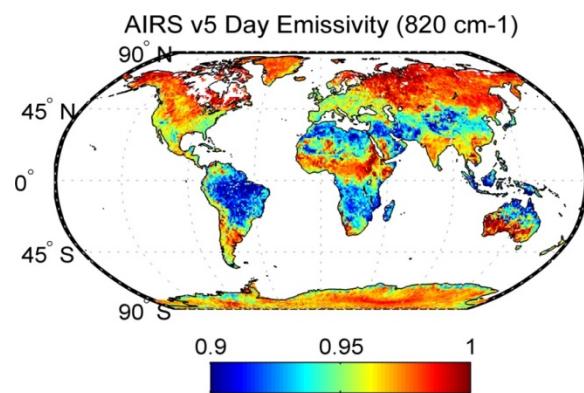
Daytime LST
Jan. 2007
QC [0,1]
AIRS+AMSU



Nighttime LST
Jan. 2007
QC [0,1]
AIRS+AMSU

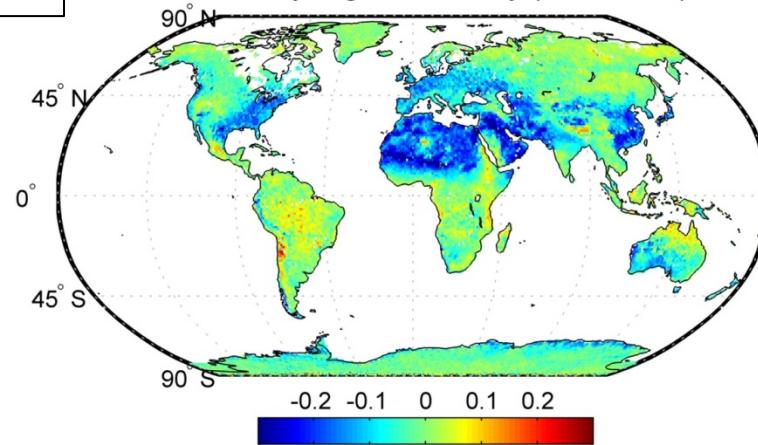


Daytime
Jan. 2007
QC [0,1]
AIRS+AMSU

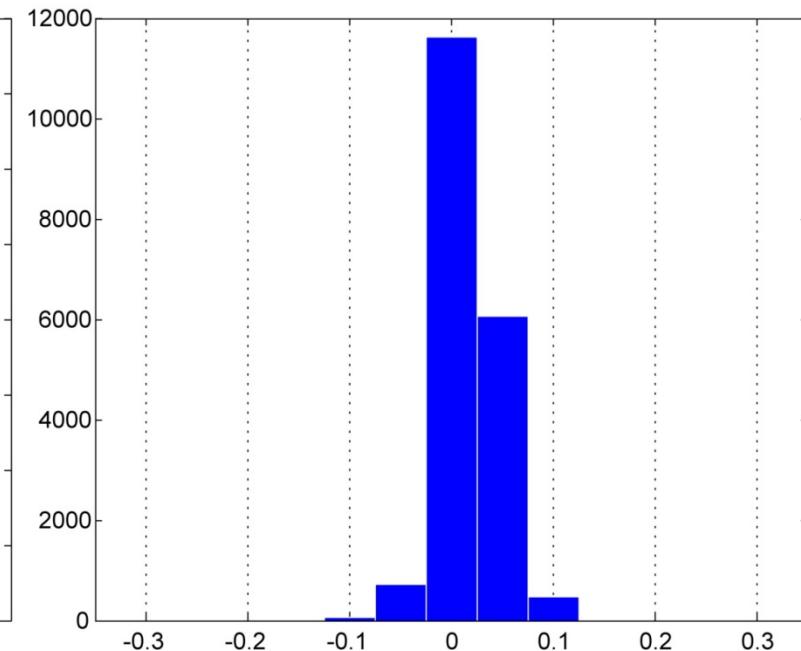
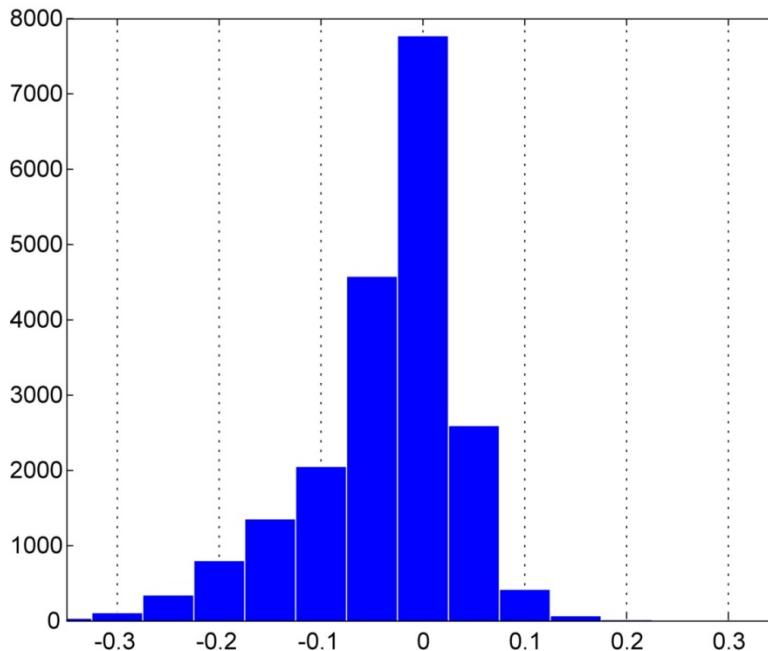
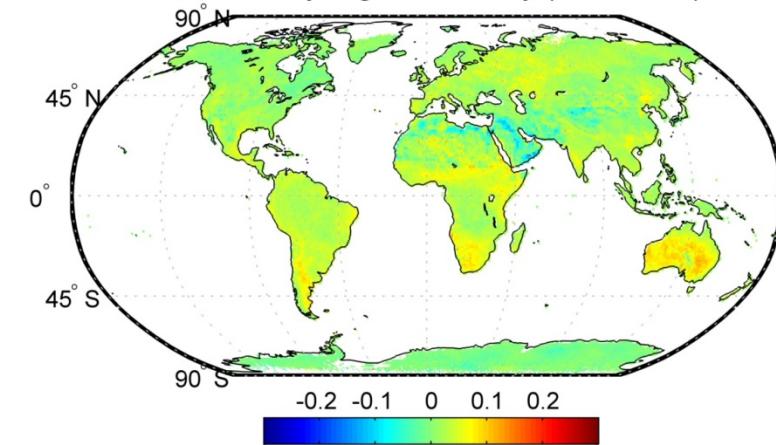


Jan. 2007
QC [0,1]
AIRS+AMSU

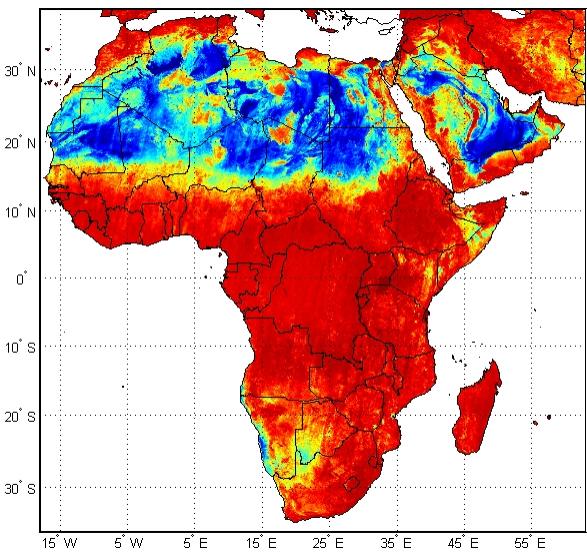
AIRS v5 Day-Night Emissivity (2632 cm⁻¹)



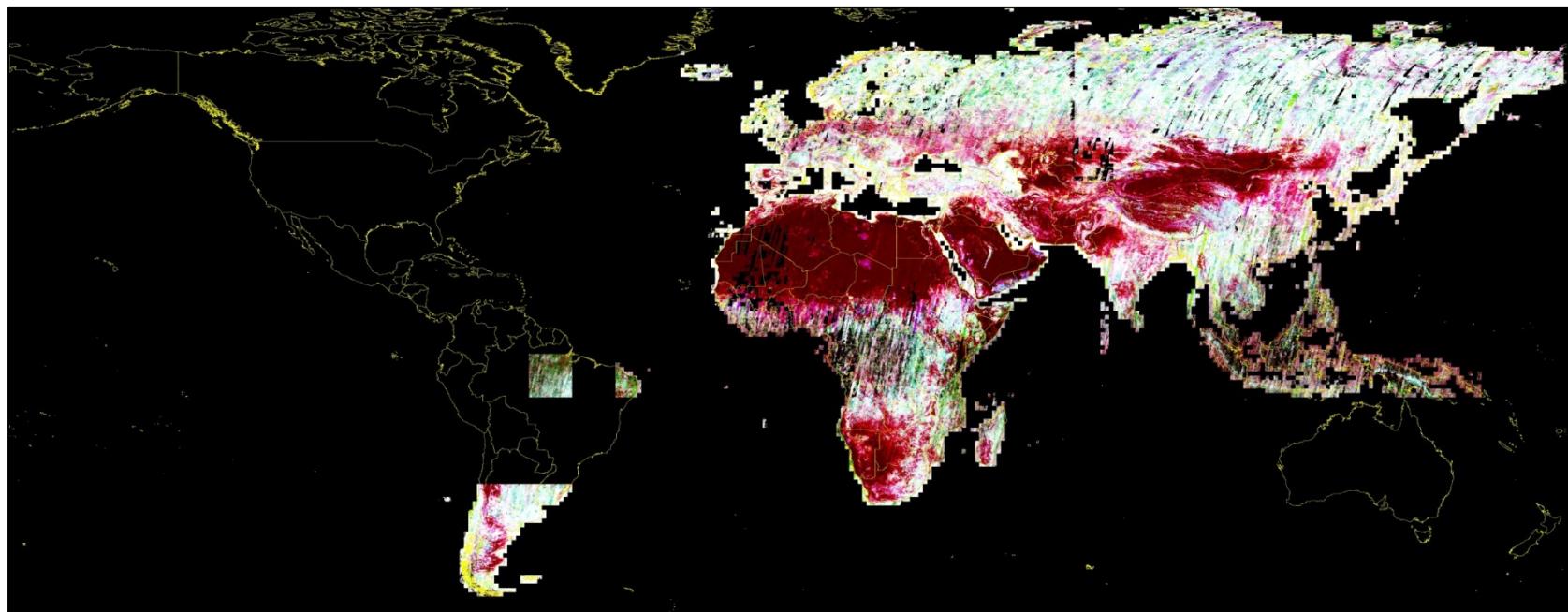
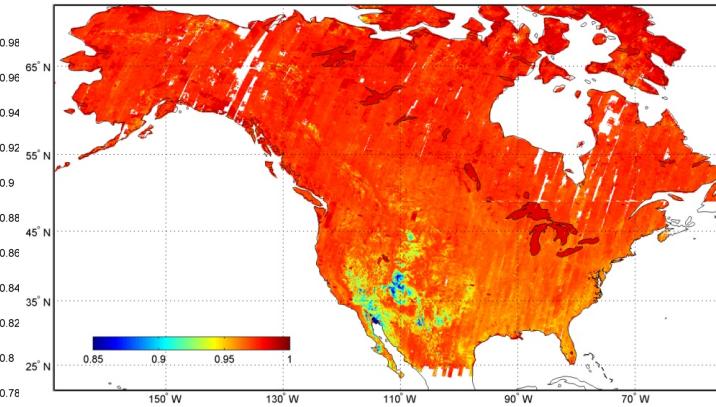
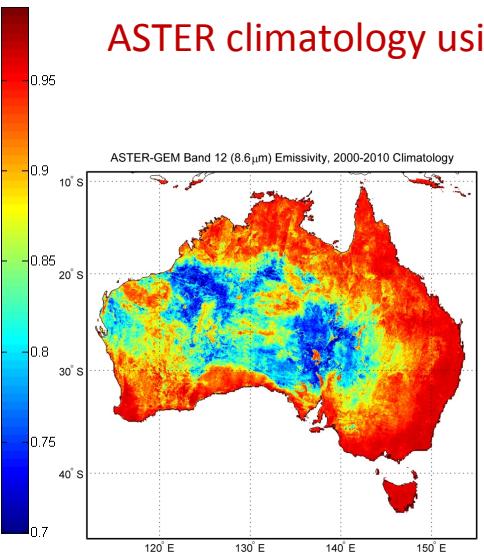
AIRS v6 Day-Night Emissivity (2632 cm⁻¹)



ASTER Global Emissivity Map (ASTER-GEM)



ASTER climatology using all data ever acquired since 2000



MODIS LST&E Products

MODIS LST Products	ATBD Accuracy	Dimensions	Spatial Resolution	Temporal Resolution	Algorithm	Output Products
MOD11	1 K	2030 lines 1354 pixels/line	1km at nadir	Swath 2x daily	Split-Window	- LST
MOD11B1	1 K	200 rows 200 columns	~5 km (v4) ~6 km (v5)	Sinusoidal 2x daily	Day/Night	- LST - Emissivity (bands 20-23, 29, 31,32)
MOD11C3	1 K	360°x180° Global	0.05° x 0.05°	Monthly	Day/Night + Split-Window	- LST - Emissivity (bands 20-23, 29, 31-32)
*MOD21	1 K	2030 lines 1354 pixels/line	1km at nadir	Swath 2x daily	ASTER Temperature Emissivity Separation (TES)	- LST - Physical Emissivity (bands 29, 31, 32)

* New MODIS LST product developed at JPL

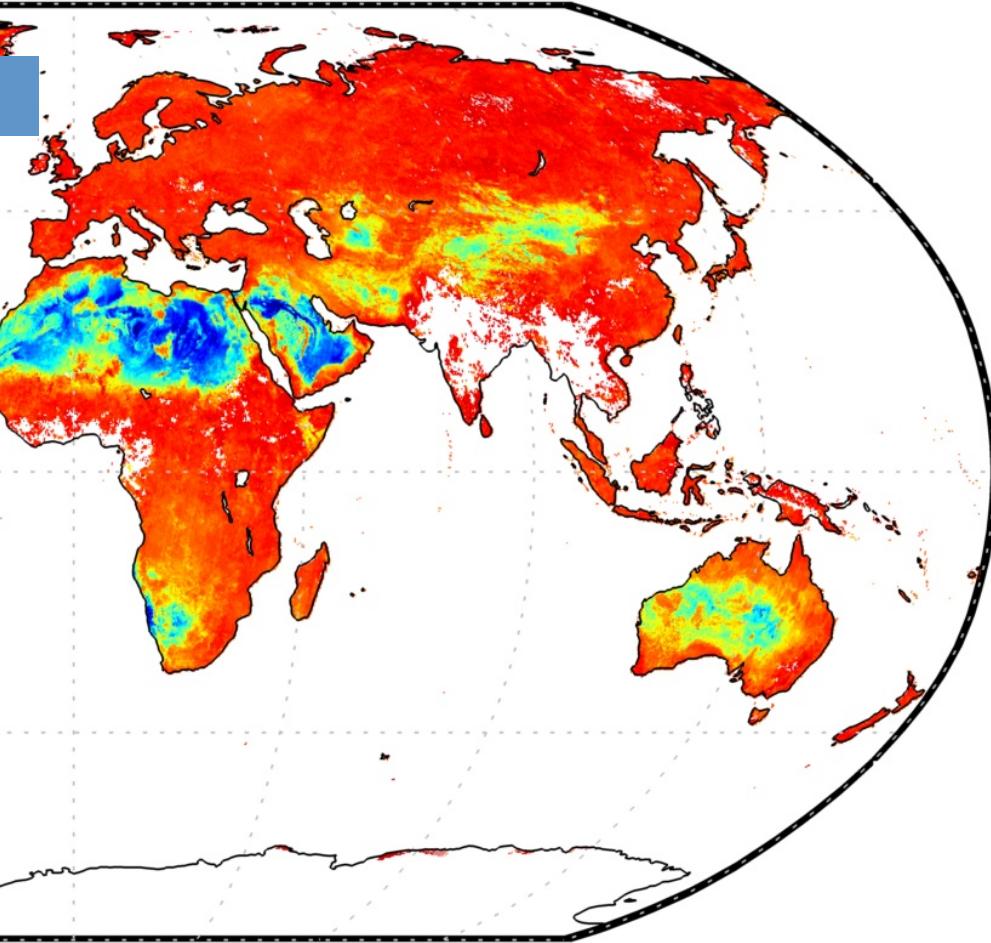
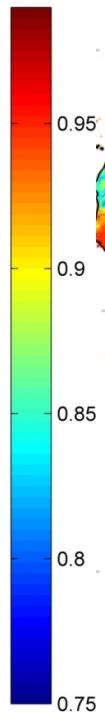
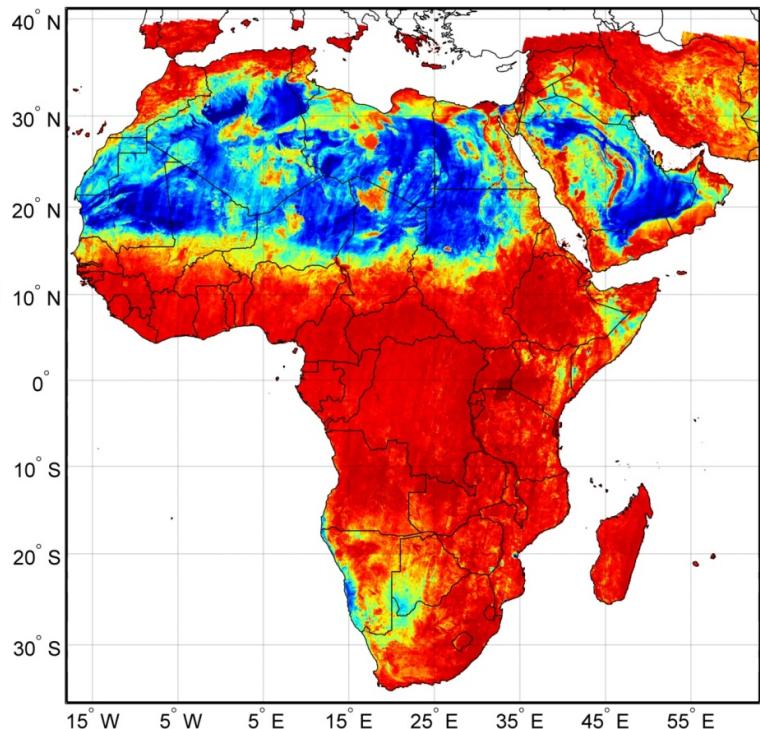
* Highest spatial resolution emissivity product available for MODIS for both day and night

MOD21 Band 29 (8.55 μ m) Emissivity, 8-day mean, August 2004

90° N

ASTER Global Emissivity Map (GEM)

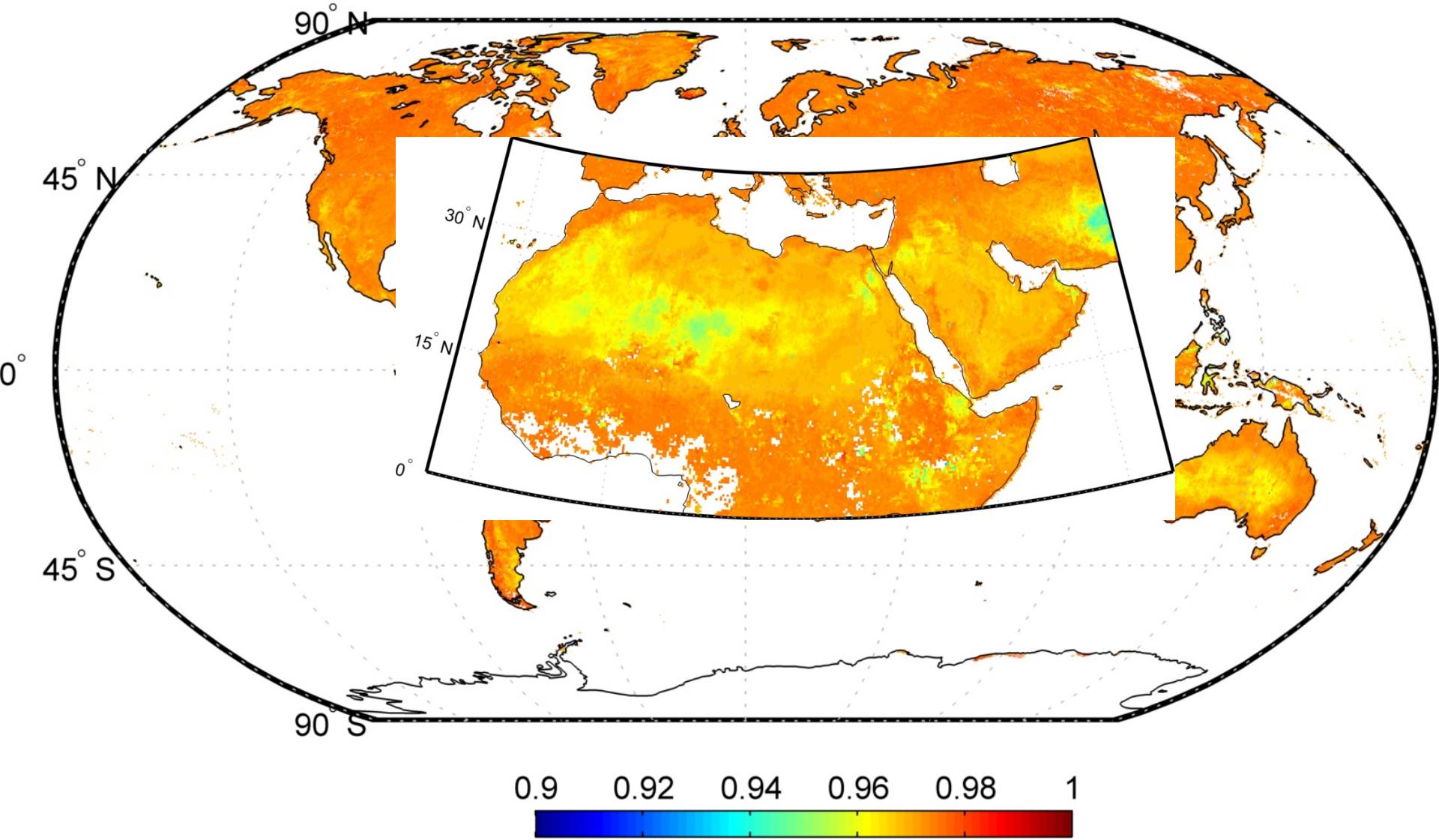
ASTER-GEM Band 11 (8.6 μ m) Emissivity, 2000-2010 Climatology



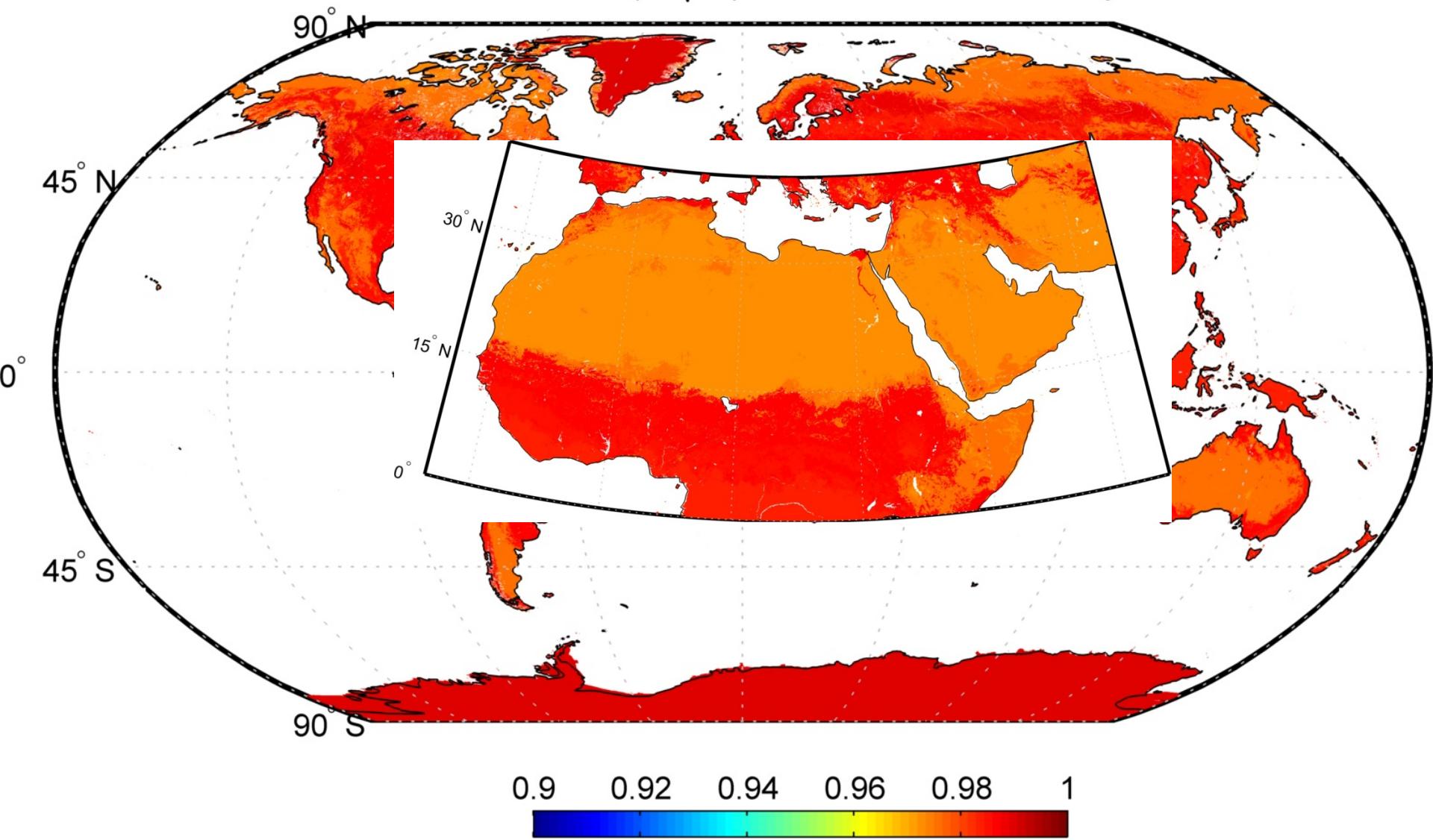
0.75 0.8 0.85 0.9 0.95 1



MOD21 Band 31 (11 μm) Emissivity, 8-day mean, August 2004

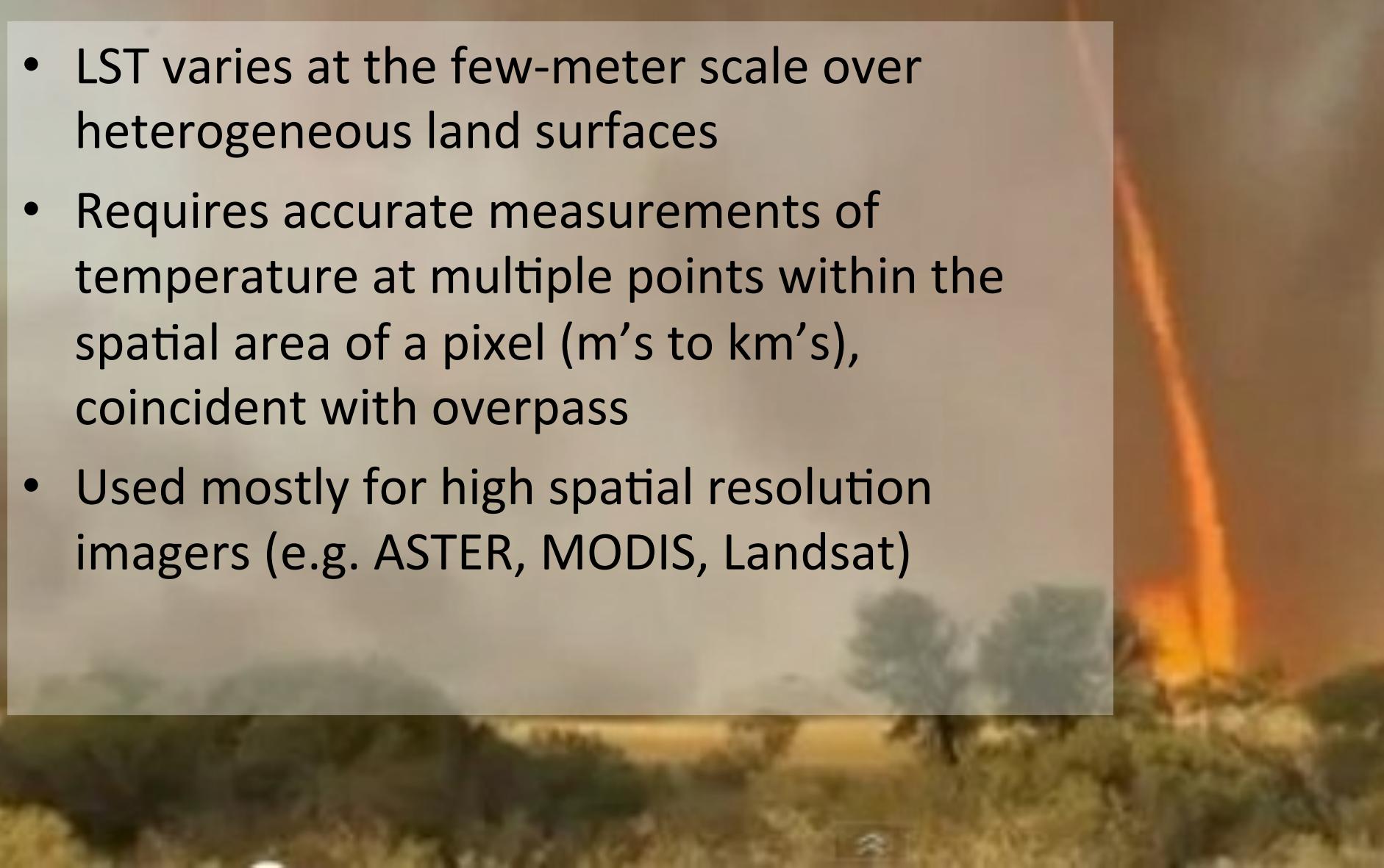


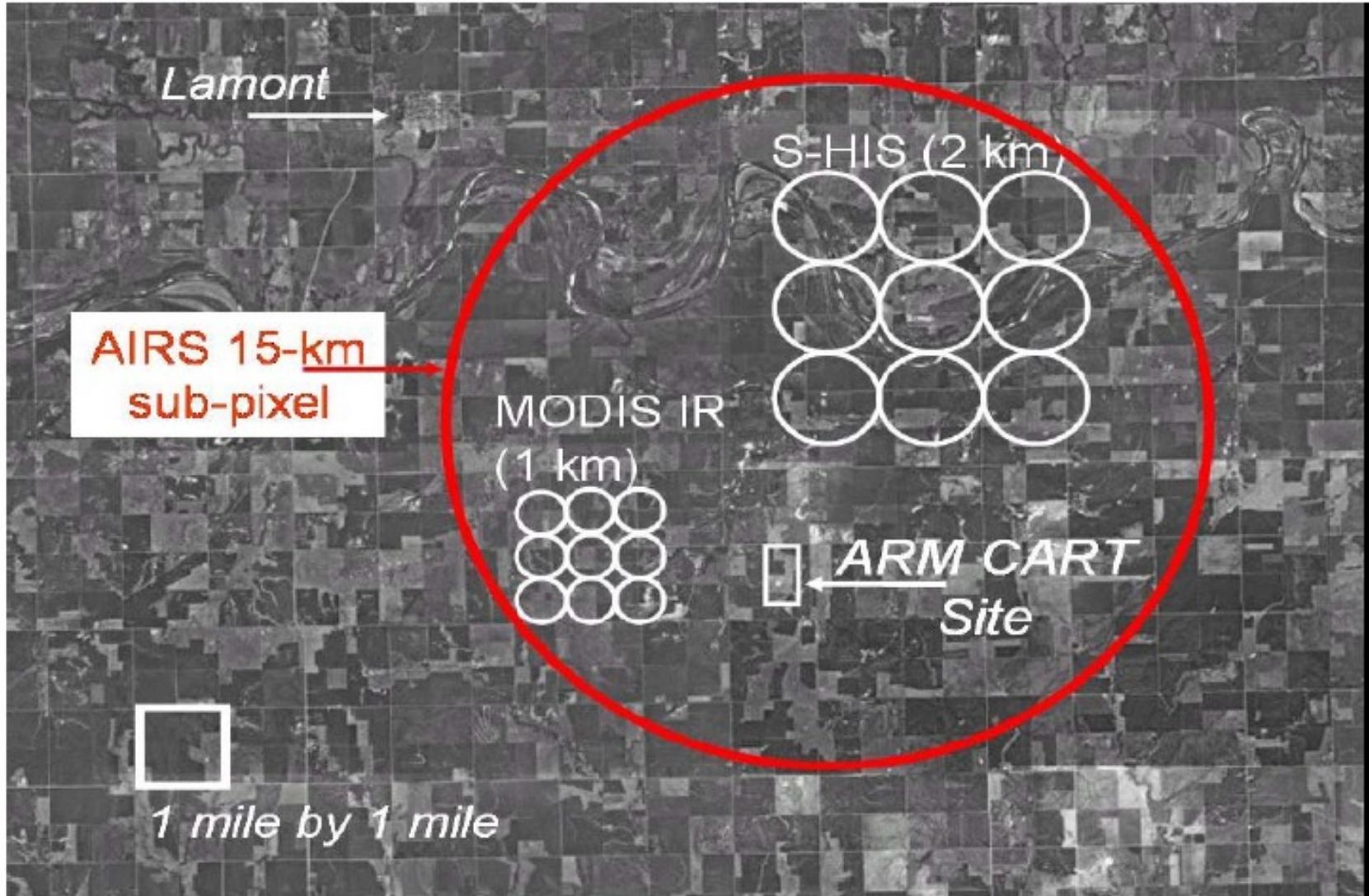
MOD11 Band 32 (12 μm) Classification Emissivity



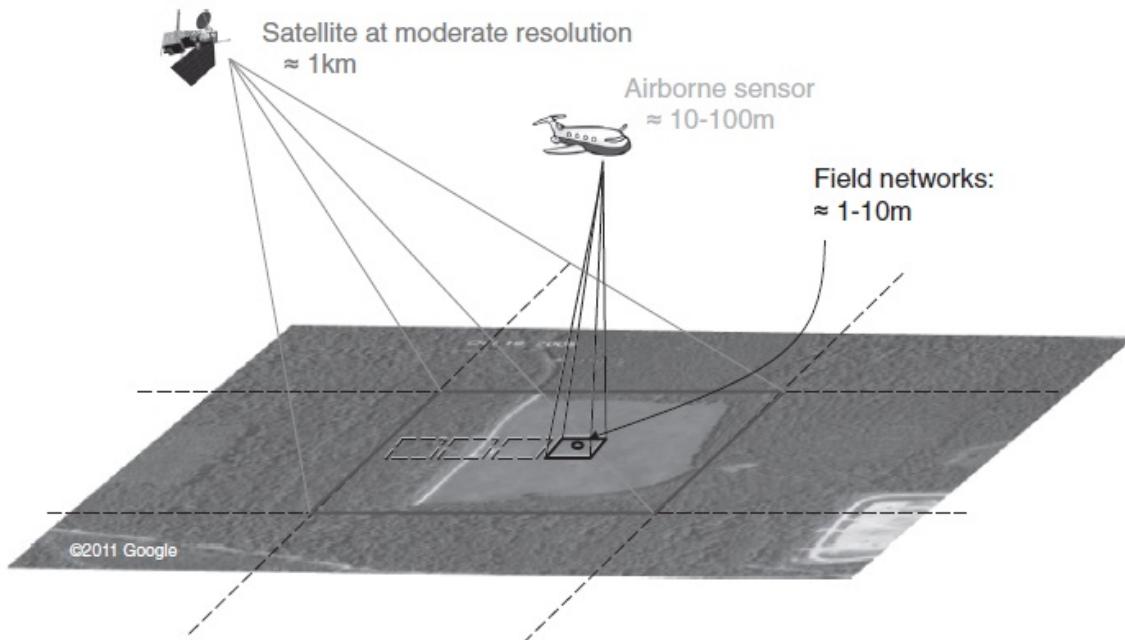
Temperature-Based LST Validation

- LST varies at the few-meter scale over heterogeneous land surfaces
- Requires accurate measurements of temperature at multiple points within the spatial area of a pixel (m's to km's), coincident with overpass
- Used mostly for high spatial resolution imagers (e.g. ASTER, MODIS, Landsat)

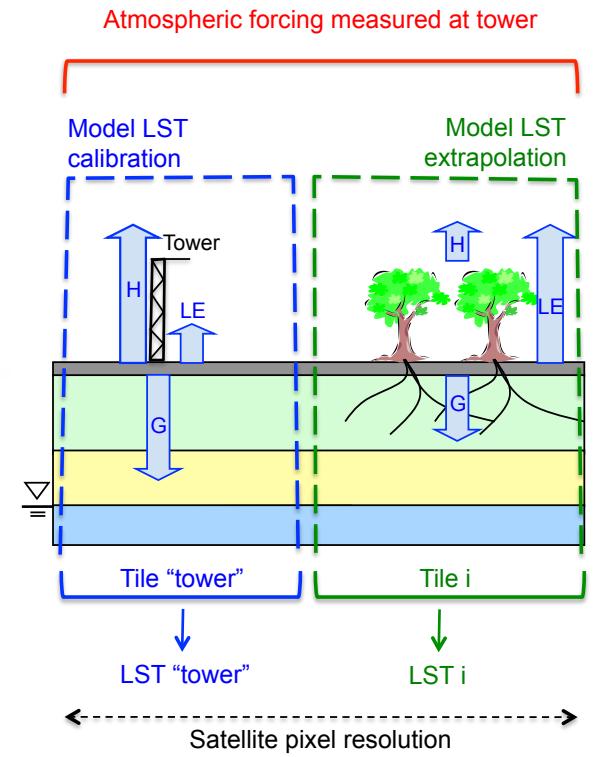




Scaling Methodology for LST validation

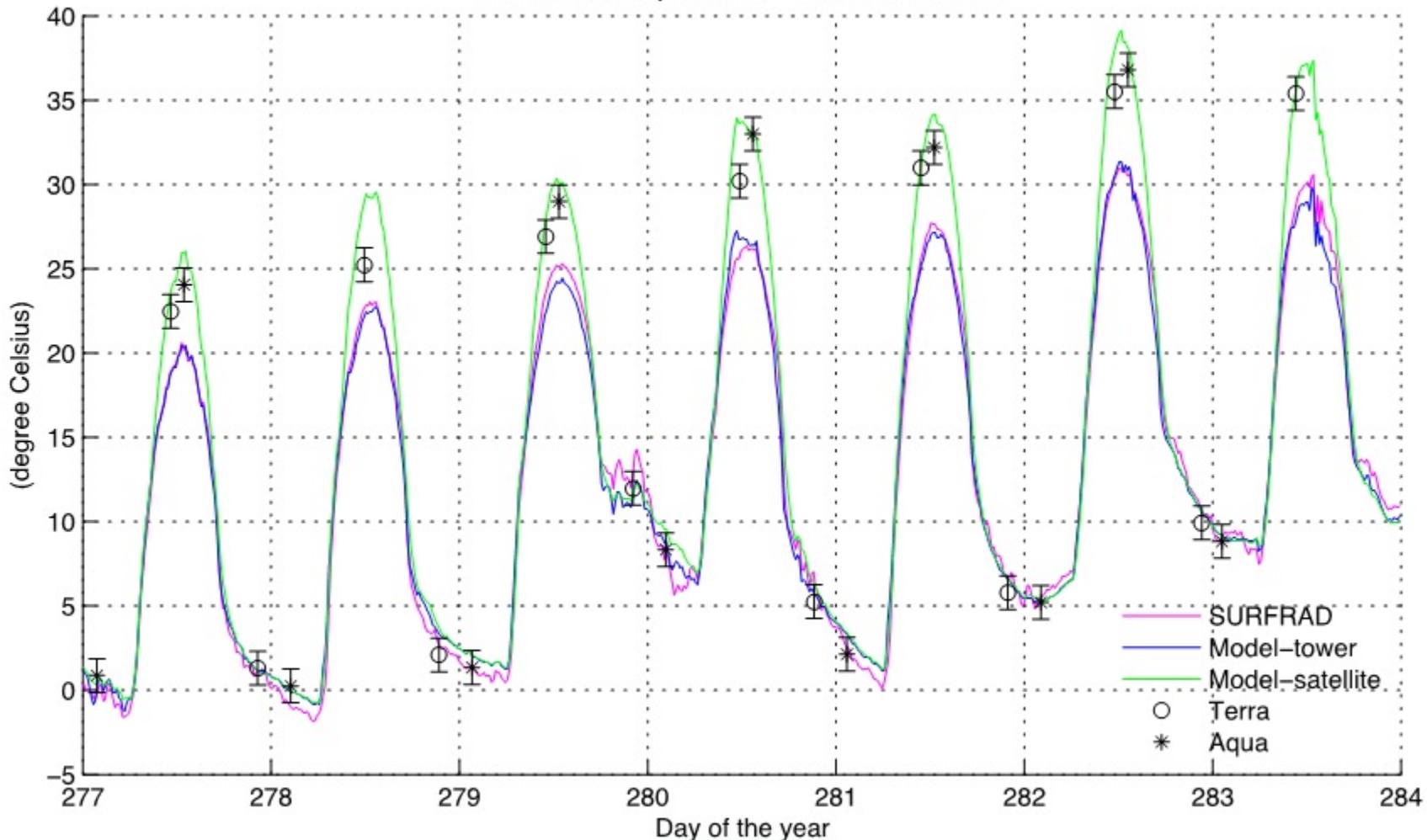


SetHys Land Model



SetHys Model LST Results

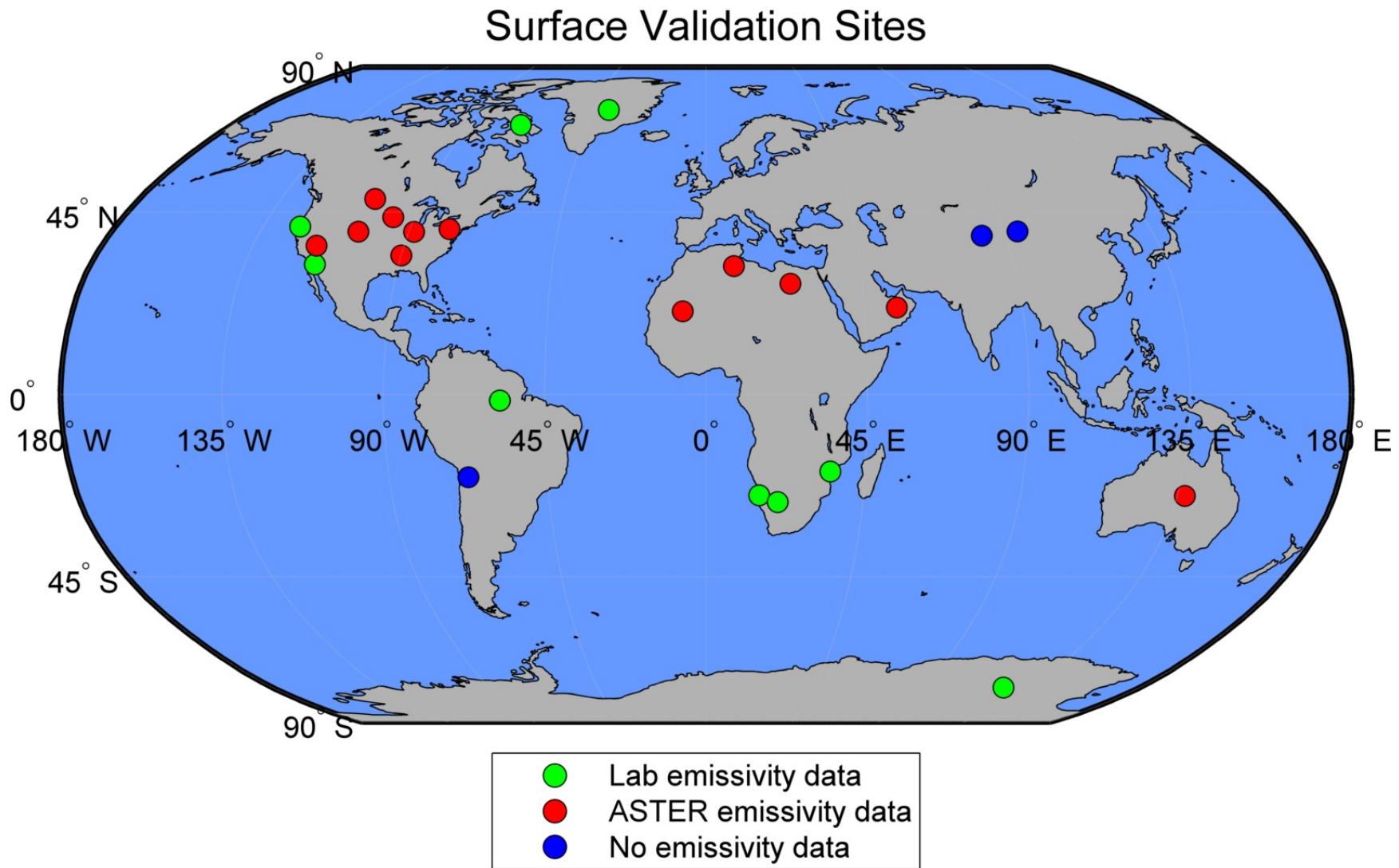
Surface Temperature – Bondville 2010

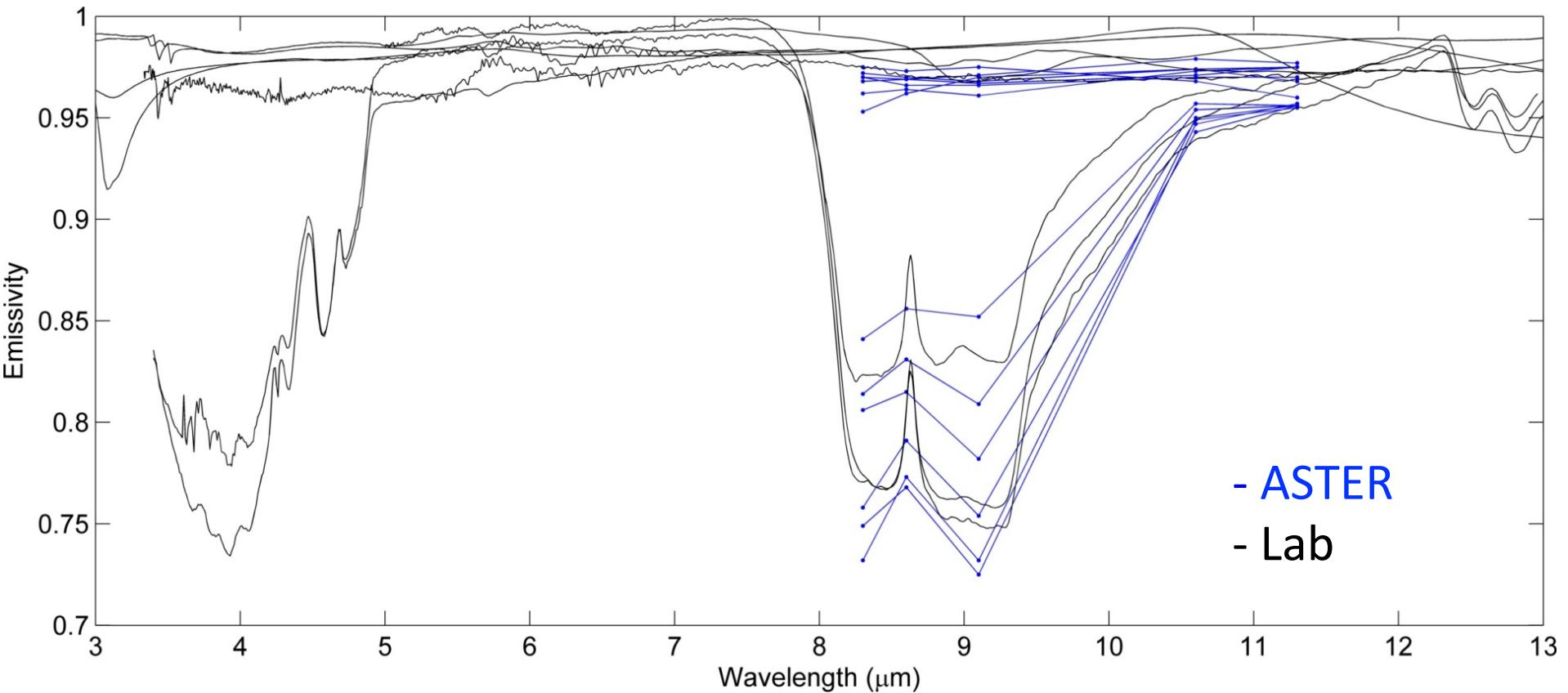


Radiance-Based LST Validation

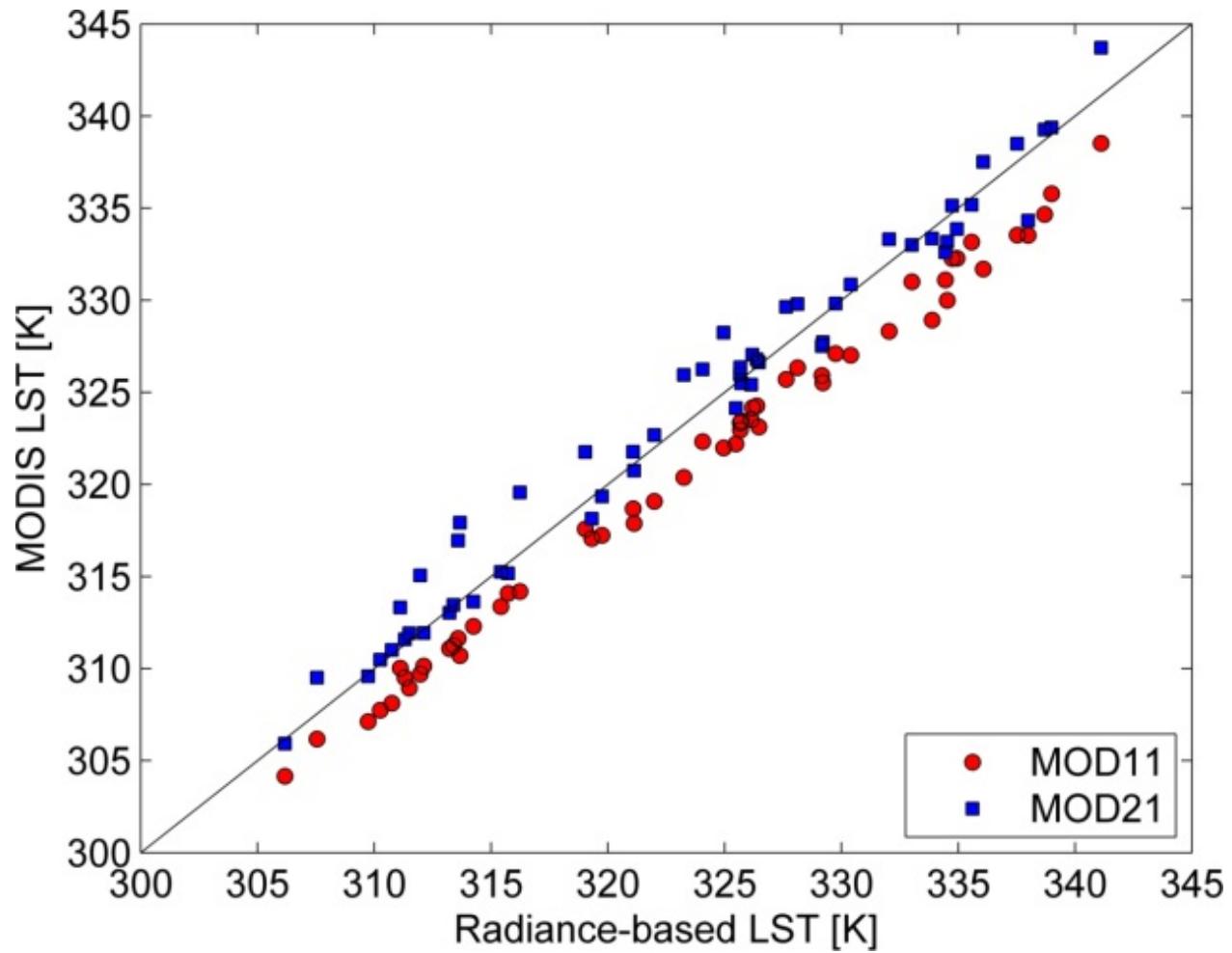
- Requires compositionally homogeneous pixels (e.g. sand dunes) with known emissivity
- Radiative closure simulation:
 - Atmospheric profiles (e.g. NCEP, ECMWF)
 - In situ emissivity data
 - Retrieved LST
 - input to RT model (e.g. MODTRAN, SARTA)
- Retrieved LST is adjusted until calculated radiances match observed radiance
 - LST uncertainty = retrieved LST minus adjusted LST

AIRS surface validation sites





MODIS Radiance-based LST Validation



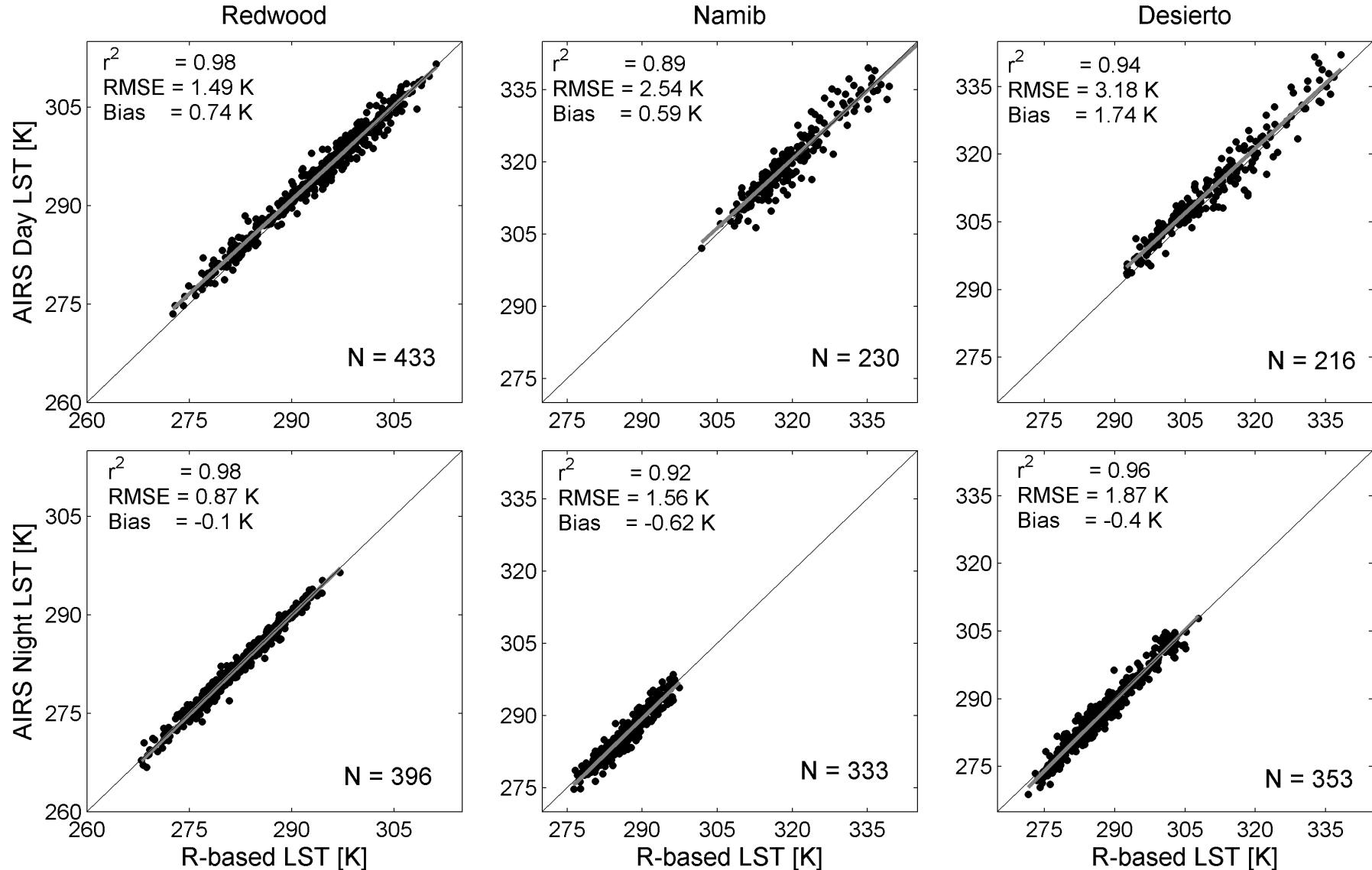
MOD11 cold bias of ~3 K (incorrect assumption of emissivity)

MODIS Radiance-based LST Validation

	MOD11 LST Bias (K)	MOD21 LST Bias (K)
Algodones (197 scenes)	-2.6587	0.5018
Great Sands (123 Scenes)	-4.708	0.4333
Kelso (210 scenes)	-4.5234	-0.6574
Killpecker (147 scenes)	-4.072	-0.0866
Little Sahara (159 scenes)	-3.4255	0.5274
White Sands (102 scenes)	-0.0583	0.4843

MOD11 cold bias up to 5 K over arid, semi-arid sites
(ATBD accuracy is 1 K!!)

AIRS v5 Radiance-based LST Validation



AIRS v5 daytime RMSE of 2-3 K over arid sites

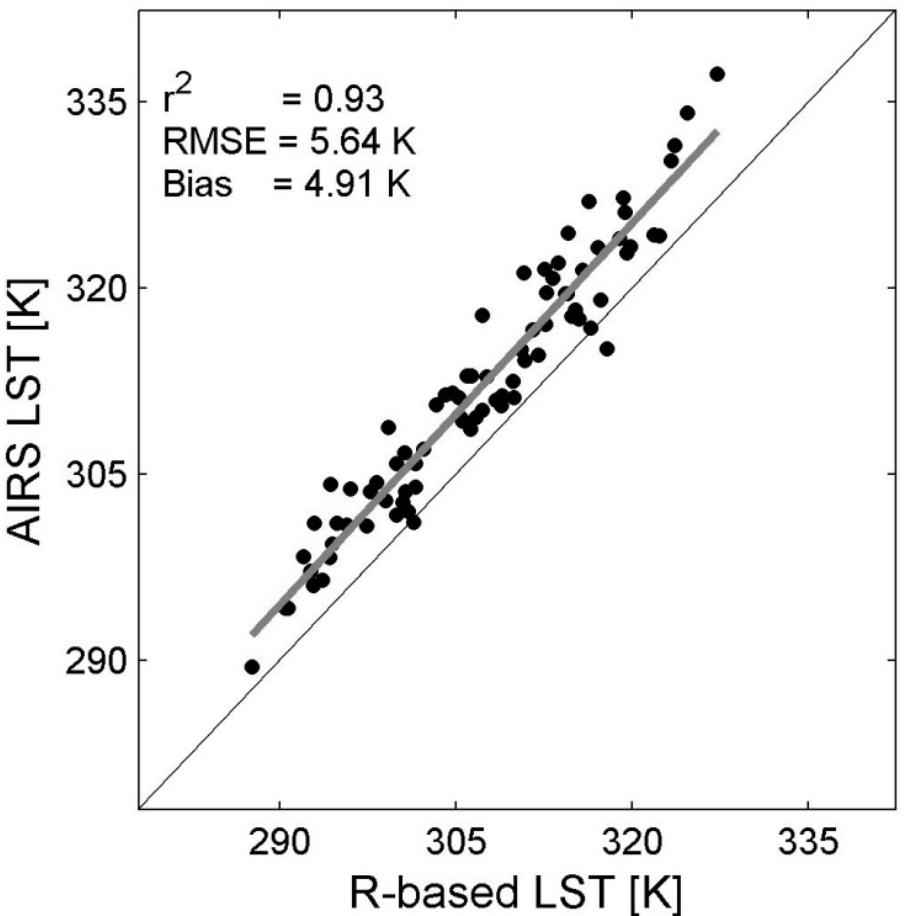
Hulley, G. C., and S. J. Hook (2012), *J. Geophys. Res. Lett.*



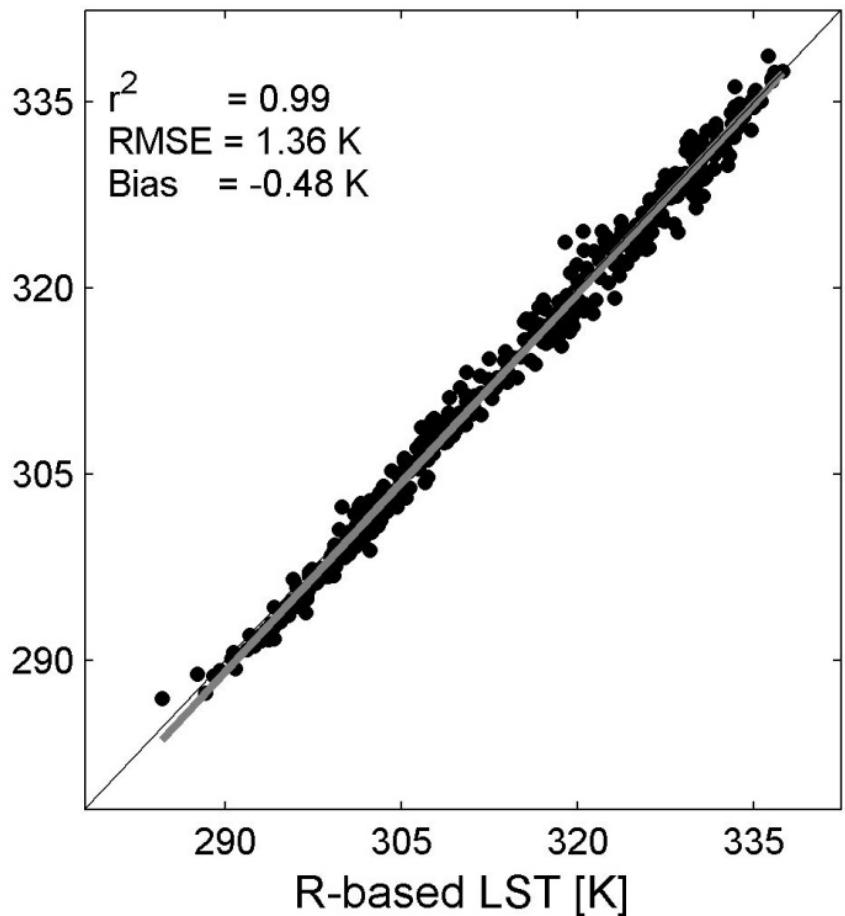
Grand Erg Oriental, Algeria

- Day
- 2003-2010
- Cldfrac<0.5
- View <45
- QA {0,1}

v5



v6



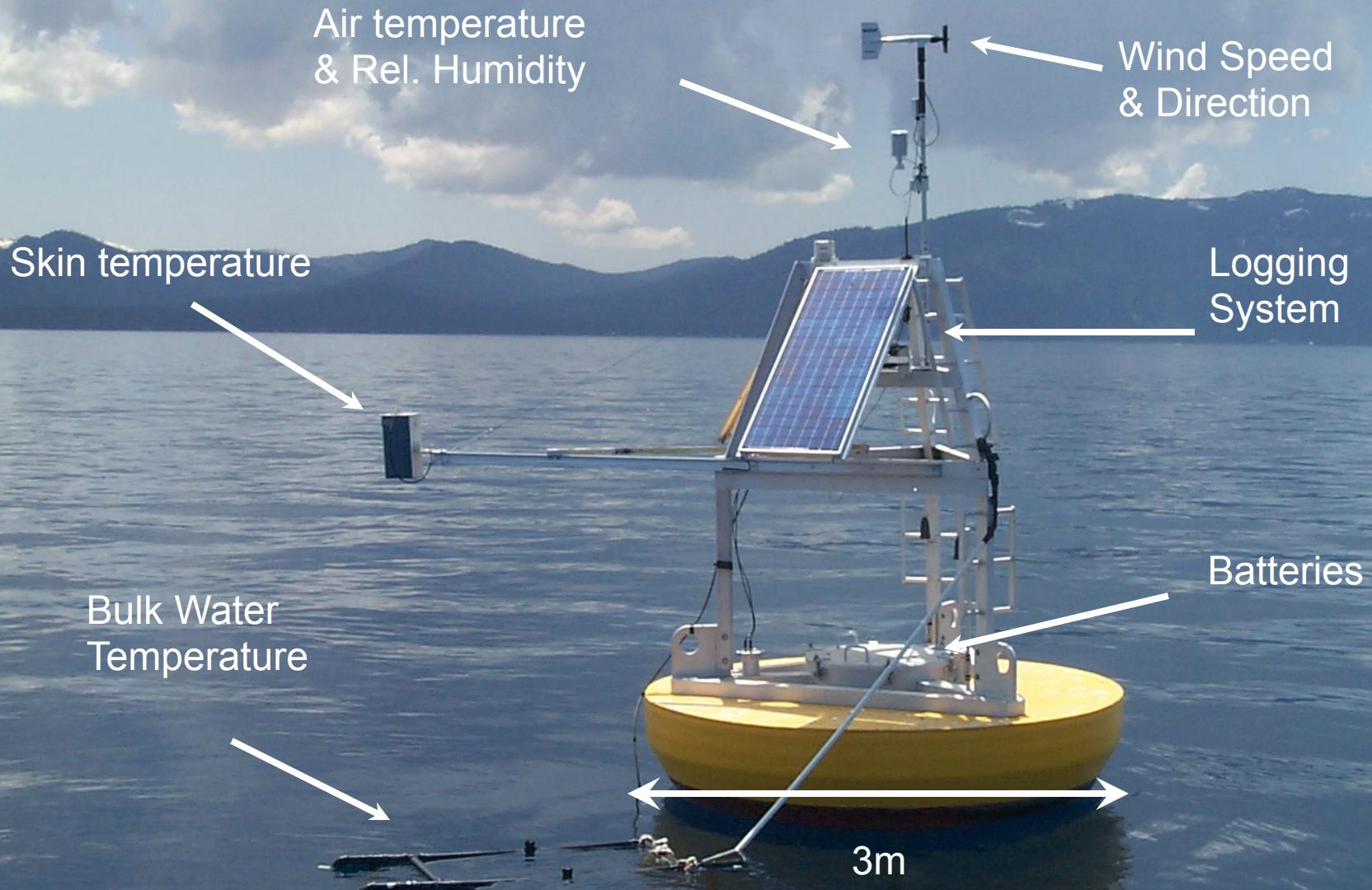
The End

National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

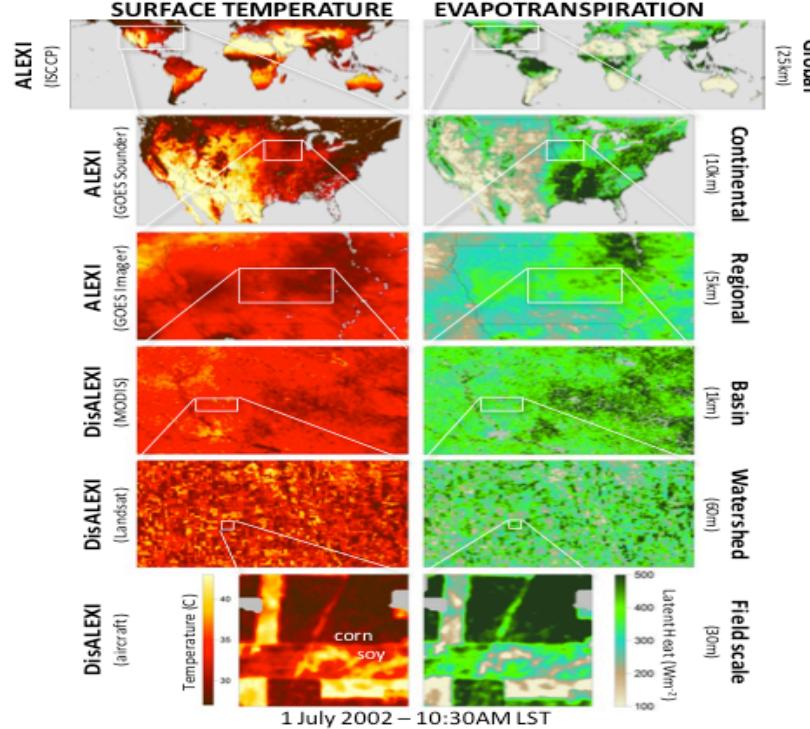
www.nasa.gov

Temperature-based validation at Lake Tahoe



6/17/2003 1:20pm

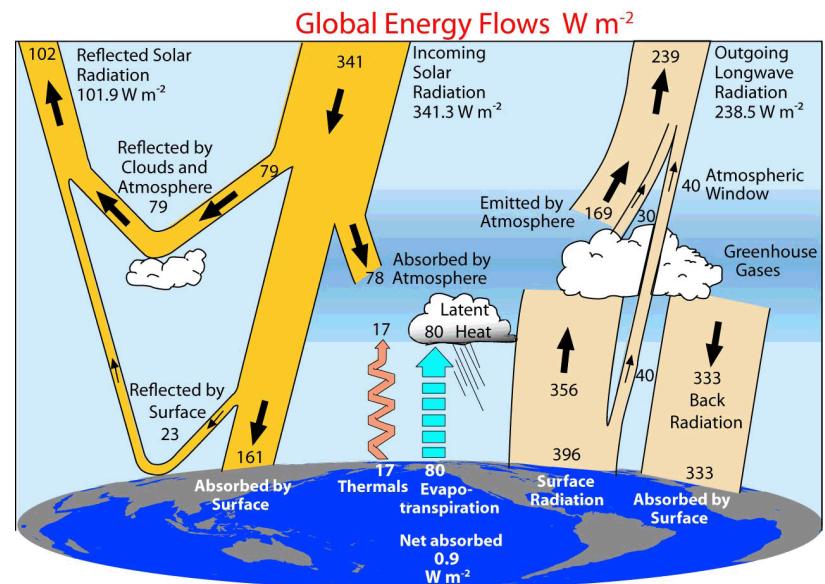
Evapotranspiration (drought monitoring)



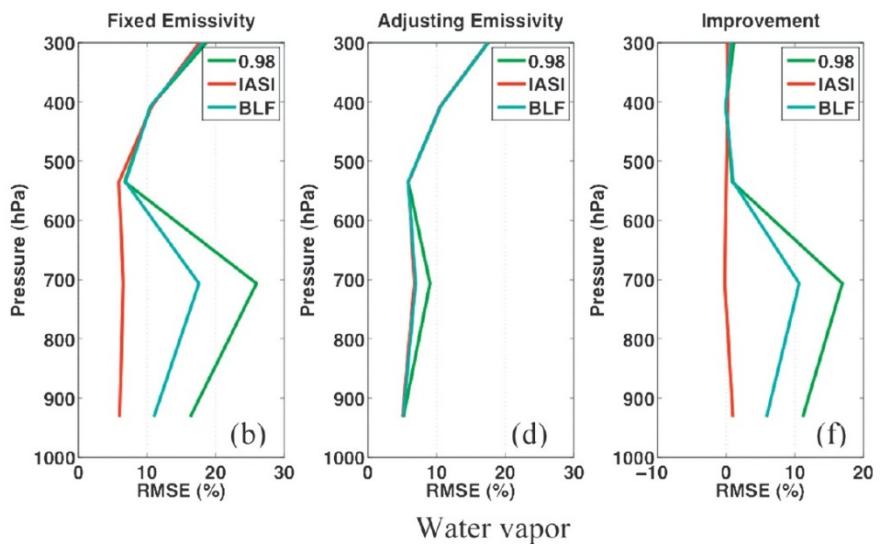
Urban Heat Island Studies



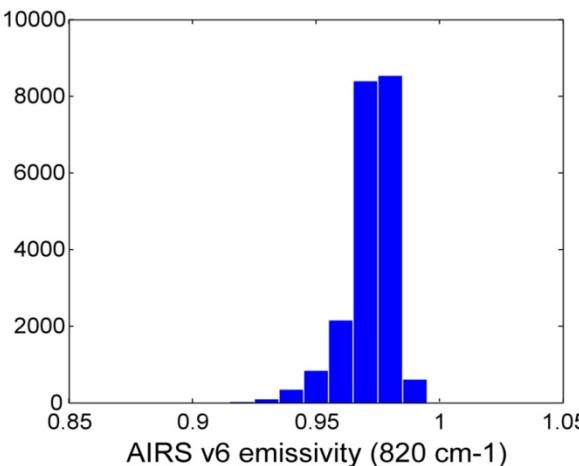
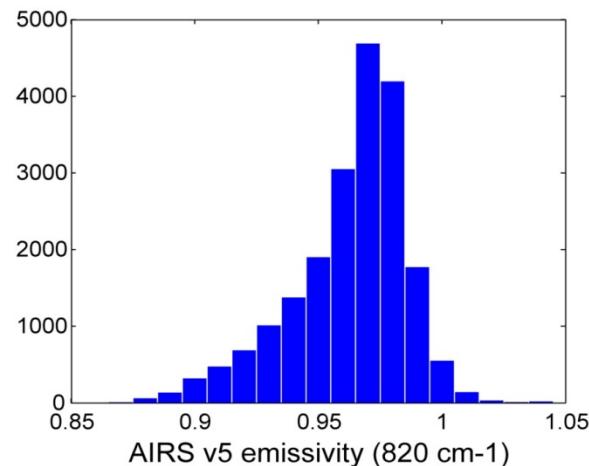
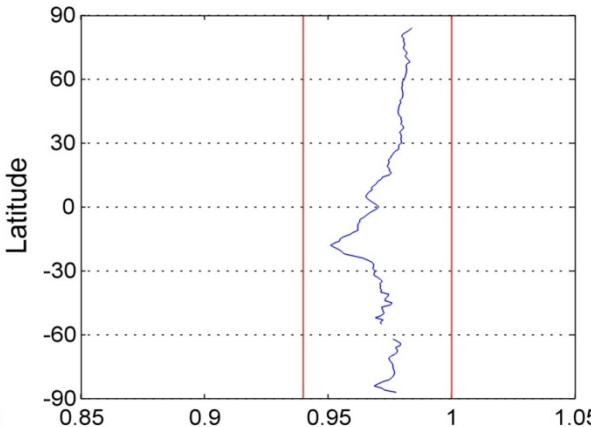
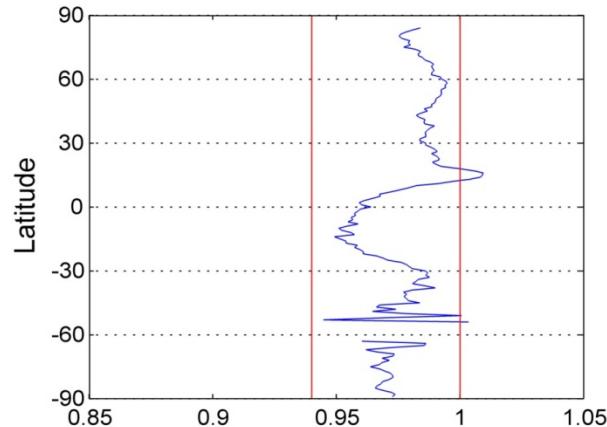
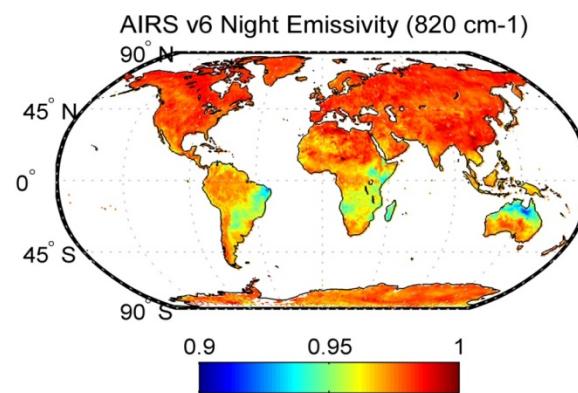
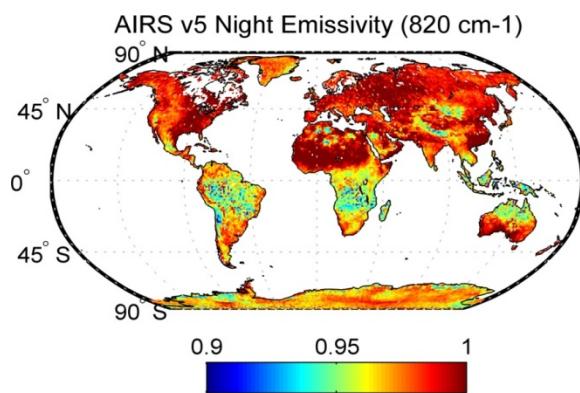
Surface Energy Balance modeling



Atmospheric profile retrievals



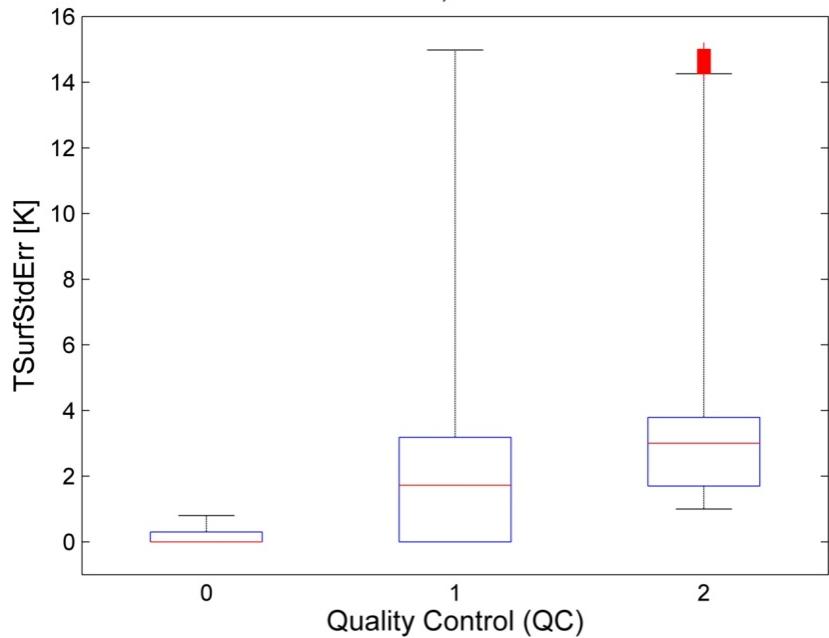
Nighttime
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QC [0,1]
AIRS+AMSU



Standard errors vs Yields

V5

AIRS v5, Jan 2007



V6

AIRS v6, Jan 2007

